PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Tomihisa ODA et al. Attn: PCT Branch

Application No. New U.S. National Stage of PCT/IB04/001829

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For: SPARK IGNITION INTERNAL COMBUSTION ENGINE

SUBMISSION OF THE ANNEXES TO THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT ON PATENTABILITY

Commissioner for Patents
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Sir:

Attached hereto is a submission of the annexes to the International Preliminary Examination Report (Form PCT/IPEA/409). The attached translated material replaces page 2 in the specification and all claims.

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the case of a large deviation in the mixing proportion, the apparatus may be incapable of achieving a practical effect.

With Document US 5 109 821 an engine control system for compensation of a detection value of a blend ration sensor with a detection value of a nock sensor or causes trouble detecting means to detect a failure of the blend ratio sensor and memories the blend ratio before the failure as an assumed blend ratio is known.

Document US 2002/139111 A1 shows a spark ignition internal combustion engine in which a high-octane fuel and a low-octane fuel are mixed so that a mixing proportion is variable by fuel mixture means and a mixed fuel is supplied into a combustion chamber, wherein a standard octane number is set in accordance with an operation state of the internal combustion engine, and a first mixing proportion between the high-octane fuel and the low-octane fuel is adjusted so as to achieve the standard octane number, and a reference ignition timing corresponding to the standard octane number is set, and knocking measurement means is provided in the spark ignition internal combustion engine, and the knocking measurement means measures a state of occurrence of knocking during a predetermined operation state of the spark ignition internal combustion engine.

SUMMARY OF THE INVENTION

[0005] It is an object of the invention to provide a spark ignition internal combustion engine in which a high-octane fuel and a low-octane fuel are mixed and supplied to the engine, and the mixing proportion between the high-octane fuel and the low-octane fuel in the mixed fuel can be determined.

[0006] In accordance with a first aspect of the invention, a spark ignition internal combustion engine in which a high-octane fuel and a low-octane fuel are mixed so that a mixing proportion is variable by fuel mixture means and a mixed fuel is supplied into a combustion chamber, is characterized in that a standard octane number is set in accordance with an operation state of the spark ignition internal combustion engine, and a first mixing proportion between the high-octane fuel and the low-octane fuel is adjusted so as to achieve the standard octane number, and a reference ignition timing corresponding to the standard octane number is set, and knocking measurement means and mixing proportion estimation means are provided in the spark ignition internal combustion engine, and the knocking measurement means measures a state of occurrence of knocking during a predetermined operation state of the spark ignition internal combustion engine, and the mixing proportion estimation means determines a deviation value between a second mixing proportion between the high-octane fuel and the low-octane fuel really supplied into the combustion chamber and the first mixing proportion, the deviation value being set based on the measured state of occurrence of knocking, and estimates the second mixing proportion between the high-octane fuel and the low-octane fuel based on the deviation value.

[0007] In the first aspect of the invention, the high-octane fuel and the low-octane fuel are mixed at a variable mixing proportion and supplied into a combustion chamber by the fuel mixture means. A standard octane number is set in accordance with the operation state, and the mixing proportion between the high-octane fuel and the low-octane fuel is adjusted so as to achieve the standard octane number, and a reference ignition timing corresponding to the standard octane number is set. The state of occurrence of knocking during a predetermined operation state is measured. On the basis of the measured state of occurrence of knocking, a deviation from the set mixing

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Claims

1. A spark ignition internal combustion engine in which a high-octane fuel and a low-octane fuel are mixed so that a mixing proportion is variable by fuel mixture means (13a, 13b) and a mixed fuel is supplied into a combustion chamber,

   characterized in that

   a standard octane number is set in accordance with an operation state of the spark ignition internal combustion engine, and a first mixing proportion between the high-octane fuel and the low-octane fuel is adjusted so as to achieve the standard octane number, and a reference ignition timing corresponding to the standard octane number is set, and knocking measurement means (10b) and mixing proportion estimation means are provided in the spark ignition internal combustion engine, and the knocking measurement means (10b) measures a state of occurrence of knocking during a predetermined operation state of the spark ignition internal combustion engine, and the mixing proportion estimation means determines a deviation value between a second mixing proportion between the high-octane fuel and the low-octane fuel really supplied into the combustion chamber and the first mixing proportion, the deviation value being set based on the measured state of occurrence of knocking, and estimates the second mixing proportion between the high-octane fuel and the low-octane fuel based on the deviation value.

2. The spark ignition internal combustion engine according to claim 1, characterized in that if the second mixing proportion is different from the first mixing proportion, an amount of the high-octane fuel and/or an amount of the low-octane fuel supplied into the combustion chamber are/is changed so that the second mixing proportion becomes substantially equal to the first

mixing proportion.

3. The spark ignition internal combustion engine according to claim 1 or 2, characterized in that if knocking does not occur during the predetermined operation state, the ignition timing is advanced.

4. The spark ignition internal combustion engine according to any one of claims 1 to 3, characterized in that if knocking occurs during the predetermined operation state, a proportion of the high-octane fuel is increased.

5. The spark ignition internal combustion engine according to any one of claims 1 to 4, characterized in that the knocking measurement means (10b) executes a knock control of retarding the ignition timing in accordance with a strength of knocking when knocking occurs, and the mixing proportion estimation means estimates the second mixing proportion based on an amount of retardation of the ignition timing caused by the knock control.

6. The spark ignition internal combustion engine according to claim 5, characterized in that the amount of retardation of the ignition timing caused by the knock control is corrected by an intake air temperature.

7. The spark ignition internal combustion engine according to any one of claims 1 to 6, characterized in that the fuel mixture means (13a, 13b) mixes the high-octane fuel and the low-octane fuel so as to achieve the standard octane number based on a known nominal octane number of the high-octane fuel and a known nominal octane number of the low-octane fuel.

8. The spark ignition internal combustion engine according to any one of claims 1 to 7, characterized by further comprising actual octane number detection means adapted for detecting an actual octane number of the low-octane fuel

and an actual octane number of the high-octane fuel, wherein the fuel mixture means (13a, 13b) sets a third mixing proportion between the high-octane fuel and the low-octane fuel in accordance with the operation state so as to achieve the standard octane number based on the actual octane number of the high-octane fuel detected by the actual octane number detection means and the actual octane number of the low-octane fuel detected by the actual octane number detection means.

9. The spark ignition internal combustion engine according to claim 8, characterized in that the actual octane number detection means sets a proportion of the low-octane fuel at 100% to measure the state of occurrence of knocking during the predetermined operation state, and determines the actual octane number of the low-octane fuel based on the measured state of occurrence of knocking, and mixes the low-octane fuel whose actual octane number has been determined with the high-octane fuel at a predetermined proportion, and measures the state of occurrence of knocking during the predetermined operation state, and determines the actual octane number of the high-octane fuel based on the measured state of occurrence of knocking.

10. The spark ignition internal combustion engine according to any one of claims 1 to 9, characterized by further comprising a fuel separator device (4) that separates a fuel into the high-octane fuel and the low-octane fuel, wherein the mixing proportion estimation means determines whether the fuel separator device (4) is normally operating so as to separate the fuel into the high-octane fuel having a predetermined octane number and the low-octane fuel having a predetermined octane number.

11. The spark ignition internal combustion engine according to claim 10, characterized in that, in the fuel separator device (4), a fourth mixing proportion in accordance with the operation state is set so as to attain the

standard octane number on an assumption that the separated high-octane fuel and the separated low-octane fuel have the predetermined octane numbers, and the mixing proportion estimation means determines that an operation of the fuel separator device (4) is abnormal if the deviation value between the second mixing proportion determined based on the state of occurrence of knocking and the fourth mixing proportion is greater than a predetermined criterion value.

12. The spark ignition internal combustion engine according to any one of claim 1 to 11, further comprising fuel injection means for injecting the high-octane fuel and the low-octane fuel so that a mixing proportion of the high-octane fuel and the low-octane fuel corresponds to the first mixing proportion.

13. A method for estimating a mixing proportion between a high-octane fuel and a low-octane fuel which is supplied into a combustion chamber of a spark ignition internal combustion engine, characterized by comprising the steps of:

a first step of setting a standard octane number in accordance with an operation state of the spark ignition internal combustion engine;

a second step of adjusting a first mixing proportion between the high-octane fuel and the low-octane fuel so as to achieve the standard octane number;

a third step of setting a reference ignition timing corresponding to the standard octane number;

a fourth step of measuring a state of occurrence of knocking during a predetermined operation state;

a fifth step of determining a deviation value between a second mixing proportion between the high octane fuel and the low octane fuel really supplied into the combustion chamber and the first mixing proportion,

the deviation value being set based on the measured state of occurrence of knocking; and

a sixth step of estimating the second mixing proportion between the high-octane fuel and the low-octane fuel based on the deviation value.

14. A method according to claim 13 further comprising a fuel injection step during which high-octane fuel and low-octane fuel are injected in a mixing proportion of the high-octane fuel and the low-octane fuel corresponding to the first mixing proportion.